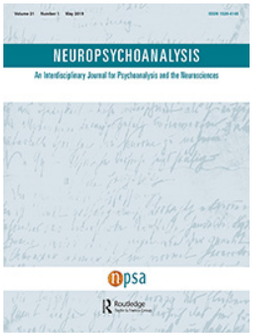

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Neuropsychoanalysis

An Interdisciplinary Journal for Psychoanalysis and the Neurosciences

ISSN: 1529-4145 (Print) 2044-3978 (Online) Journal homepage: https://www.tandfonline.com/loi/rnpa20

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To cite this article: John Dall'Aglio (2019) Of brains and Borromean knots: A Lacanian meta-neuropsychology, Neuropsychoanalysis, 21:1, 23-38, DOI: 10.1080/15294145.2019.1619091

To link to this article: https://doi.org/10.1080/15294145.2019.1619091

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NEUROPSYCHOANALYSIS
2019, VOL. 21, NO. 1, 23–38
https://doi.org/10.1080/15294145.2019.1619091

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Of brains and Borromean knots: A Lacanian meta-neuropsychology

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ABSTRACT

Meta-psychological bridges between neuroscience and psychoanalysis have focused on Freud's structural model [Kaplan-Solms & Solms, 2002. *Clinical studies in neuro-psychoanalysis: Introduction to a depth neuropsychology* (2nd ed.). London: Karnac Books; Solms, 2013. The conscious id. *Neuropsychoanalysis*, *15*(1), 5–19]. While other psychoanalytic schools have been in dialog on specific concepts, alternative full-scale meta-psychologies have received less attention. This paper maps the brain through the Lacanian triad of the real, imaginary, and symbolic. Dynamic localization of these concepts avoids neuro-structural reduction. Right and left cortical hemispheres appear necessary (but not sufficient) for imaginary and symbolic functions respectively, with the frontal lobes underlying social and self-reflective functions. The real is supported by subcortical affective and motivational structures, particularly the automatization of non-representational systems prior to hippocampal development. This project highlights the structural disjuncture (impossibility) which is constitutive of human subjectivity and brain function.

ARTICLE HISTORY
Received 26 January 2018
Accepted 8 December 2018

KEYWORDS
Lacan; metapsychology; affective consciousness; real; imaginary; symbolic; neuropsychoanalysis; psychoanalysis

Can there be a Lacanian neuropsychoanalysis?

To many, a "Lacanian neuropsychoanalysis" is an oxymoron. Lacan's theory, with its philosophical bend and emphasis on structural linguistics, tends to oppose an organic conception of the psyche. Contemporary Lacanians often endorse this view, emphasizing the immaterial subject beyond the understanding of the brain (Redmond, 2015). The neuropsychoanalytic project is seen as a bio-reductionist *cul de sac* (Laurent, 2014).

However, this reading of Lacan simplifies his criticism of the life sciences. In my reading, Lacan opposes the project of a material *whole*, an understanding of nature which guarantees total knowledge. As will be discussed, Lacan argued that this is to fall for the lure of an imaginary-symbolic reality, ignoring the real dimension of experience. Lacan opposes Nature with a capital N (Johnston, 2013b; Lacan, 1975–1976). A theory of the brain which promises to fully explain the subject of psychoanalysis is indeed, in Lacan's view and mine, a *cul de sac* which ignores the primacy of the unconscious.

However, a neuropsychoanalysis which accounts for this lack of totalized knowledge or understanding – and conceives of nature itself as inherently lacking and non-totalized – would be compatible with Lacan (Johnston, 2012). This would recognize the "beyond the brain" which is within the brain, akin to the more-than-nature within nature itself (Lacan, 1975–1976). Rather than reducing Lacanian theory to neurobiology, this Lacanian neuropsychoanalysis aims to elevate neuroscience beyond biology.

Moreover, Lacan himself interfaces with neurobiology. In his discussions of the mirror stage and the ego (Lacan, 1953, 1977, 1988), he refers to the cerebral cortex as an intra-organic mirror. Furthermore, highlighting Freud's (1895) concept of infantile helplessness, Lacan points to the infant's physical body as a state of original organic discord, a "body-in-pieces" (Johnston, 2013a). Lacan does indeed conceive of the physical sphere of the psyche – for him, the brain is premature and fragmented, lacking adaptation.

This paper presents a preliminary outline of a meta-neuropsychology of Lacan's registers of the real, the imaginary, and the symbolic. Prior Lacanian neuropsychoanalytic models (Ansermet & Magistretti, 2007; Johnston, 2013a) will be discussed. But first, Lacan's register theory will be reviewed.

Real, imaginary, symbolic: Lacan's metapsychology

It is beyond the scope of this paper to discuss Lacan's triad extensively. Certain aspects will be omitted, and not all related concepts (such as *jouissance*) will be

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discussed.[1] This reflects an attempt to establish a bedrock, upon which other concepts can be built.

Lost in reality: the mirror stage, the imaginary, and the symbolic

For Lacan, the human infant is not born adapted to the world. Rather, the infant is premature and uncoordinated, ravaged by auto-erotic partial drives (Freud, 1905). From this primal experience of intra-organic chaos, the infant turns to the Other[2] (Verhaeghe, 2004). Lacan (1977, 1988) formally depicts this process in the mirror stage, where the infant sees itself in a mirror. The infant perceives a whole, gestalt image, which it (mis)recognizes as itself. This unified image forms the ego, an ideal gestalt upon which all later imagos are built in a cycle of identifications and imitations (Muller, 1985). The wholeness of the body and of external reality rests upon this imaginary ego identification (Lacan, 1988). Lacan's term "imaginary" does not suggest that the ego is unimportant, something simply "made up" or "fake." The imaginary is rooted in images. However, Lacan's choice of this term reflects the crucial point that the *imaginal* world of perception is illusory insofar as it obscures the real (see below).

Similarly, while the ego brings (a degree of) mastery over the body, Lacan argues that it is fundamentally illusory since it contrasts with the subject's internal fragmentation. Thus, captivation with the ideal alienates the subject from its own internal experience (Lacan, 1977; Muller, 1985). Consequently, the ego's defense mechanisms involve misrecognition, of itself and of others. Alienation is the effect of imaginary identification (Verhaeghe, 2004).

In addition, the image in the mirror is *named* by the Other, adding symbolic identification through the signifier. The relationship between name and image is arbitrary – any word can suffice. Signifier and image do not bear a one-to-one relationship (Lacan, 1988; Thibierge & Morin, 2010). However, the Other (language) structures the way the imaginary image is perceived, orienting the subject's reality.

The symbolic is rooted in language, where signifiers only bear differential relationships to other signifiers. Any relationship to a signified meaning or image is arbitrary. With infinite potential significations, language fails to produce a precise meaning without ambiguity (Lacan, 1988; Miller & Roberts, 1996). Furthermore, the symbolic extends to social rules and laws governing relations among subjects – the Oedipal prohibition of the subject's enjoyment (Verhaeghe, 2004) being the most exemplary. However, desire remains inexact (Miller & Roberts, 1996), for the articulation of desire betrays the lack *beyond* the symbolic (Fink, 1999).

The real: negativity and excess

The real refers to this "negative excess," that which is lacking (i.e. absence, negativity) with respect to the symbolic and imaginary registers but nevertheless makes itself felt as excess. Indeed, Lacan (1978) abandoned his mirror stage because it obscured the importance of that which is *beyond* the imaginary and symbolic (Vanheule, 2011). Thus, Lacan's later teaching focuses on the real.

For Lacan, the proper object of psychoanalytic study is the unconscious. The analysand is referred to as a "subject" and is considered *split*. This split is not considered a flaw which must be repaired by the ego. Rather, this split is constitutive of the subject (Lacan, 2000). In Lacan's reading of the unconscious, the subject emerges in the gap (lack) in logical conscious experience. Bungled actions, slips of the tongue, dreams, and symptoms all reveal this lack in logical continuity (Verhaeghe, 2004).

At the core of the subject, the real is the nucleus of the unconscious.[3] As a negative entity, the real is not a mere nullity – it is the presence of a fault without representation. In speech, it is the unsayable – not because it is prohibited, but because it is impossible. It is the constitutive *impasse* of speech and representation. As such, the real does not *exist* (in representable reality). It *insists*, demanding repetition and disrupting the subject's organization in the other registers. The real is part of the subject *and* excessive to it – the subject is not a whole, but a subject with something beyond it. The real[4] goes beyond what the subject can speak and imagine about itself (Copjec, 2012; Lacan, 2000).

Lacan (1997) traces this concept back to Freud's (1895) *Project for a Scientific Psychology*. Freud writes on the development of speech:

> Speech innervation is originally a path of discharge … it is a portion of the path to *internal change*, which represents the only discharge till the *specific action* has been found. This path acquires a secondary function from the fact that it draws the attention of the helpful person (usually the wished-for object itself) to the child's longing and distressful state; and thereafter it serves for *communication* and is thus drawn into the specific action. At the start of the function of judgement, when the perceptions, on account of their possible connection with the wished-for object, are arousing interest … their complexes are dissected into an unassimilable component (the Thing [*das Ding*]) and one known to the ego from its own experience (attribute, activity) – what we call understanding. (Freud, 1895, p. 366, emphases in the original)

The emergence of representation (understanding) occurs *simultaneously* with the emergence of an

"unassimilable component," which is subtracted from representation itself. This subtraction is objectively registered as such (*das Ding*).

Freud describes a similar scenario in the *Three Essays*:

> At a time at which the first beginnings of sexual satisfaction are still linked with the taking of nourishment, the sexual instinct has a sexual object outside the infant's own body in the shape of his mother's breast. It is only later that the instinct loses that object, just at the time, perhaps, when the child is able to form a total idea of the person to whom the organ that is giving him satisfaction belongs. As a rule the sexual instinct [drive] then becomes auto-erotic. (Freud, 1905, p. 222)

Again, the genesis of the representation ("a total idea of the person") is simultaneous with the loss of the object of the drive. For Lacan, this loss is inseparable from – indeed, constitutive of – representation.

The real (*das Ding*, the primordial loss) is an internal, alien presence – something that is simultaneously within the subject, yet other to the subject. It is an intimate exteriority; hence, Lacan's neologism: "extimate" (Laurent, 2014). This is how Lacan understands primal repression, which is not recognized in reality and then (secondarily) repressed into the unconscious. Rather, it never existed – in Freudian terms, it never received a cathexis in the first place (Freud, 1915b, 1915c). Freud (1900) alludes to this unassimilable component of the psyche in the navel of the dream which resists a final interpretation. The unconscious is that which is both internal to subject, but also foreign to it (Lacan, 1997).

Lacan's (1978) *objet a* is a derivative of Freud's *das Ding*. The real insists in *not* being spoken. Therefore, language and symbolic-imaginary reality entail loss (of that which is impossible to articulate), since the real forever remains out of the grasp of language and representation. Thus, *objet a* is the first (non)object, the lost object, something in the register of the real, a subtraction which remains outside of the symbolic and imaginary. This loss is the loss of something which the subject never possessed in the first place. It is a remainder, a residual which emerges as loss with the entrance into the symbolic and imaginary (Morin, Pradat-Diehl, Robain, Bensalah, & Perrigot, 2003; Thibierge & Morin, 2010). Neither language nor image can represent the subject because the subject is not-whole (split), producing negative excess (loss) in representation.

The drive belongs to the real insofar as drive is untethered to actual (representable) objects. For Freud (1915a), the aim and the object are the most variable parts of the drive, in contrast to the source and pressure (Johnston, 2013a). For Lacan, the object of the drive is fantasmatic. It never existed as something which the subject possessed. Lacan (1978) terms *objet a* the object of the drive – it does not exist (as representation). This is one way to understand Freud's claim: "the finding of an object is the refinding of an object" (Freud, 1905, p. 222). The subject continually seeks this lost *objet* which escaped it from the beginning. The drive[5] does not admit of satisfaction because satisfaction follows a logic of filling a lack (reduction of tension, meeting needs). Thus, in Lacan's formulation, the drive insists, seeking excitation, not discharge, resulting in the repetition compulsion (Johnston, 2013a).

Lacan links the real to the body, the original state of organic chaos and infantile helplessness (Lacan, 1977). Johnston (2013a) describes this as a "barred corporo-real," emphasizing the not-whole (barred) nature of the corporeal body. Furthermore, Lacan (1978) gives *objet a* certain bodily coordinates: the breast, the faeces, the gaze, and the voice. One should read these coordinates of *objet a* as the points of the body where the subject lacks (is not-whole) in relation to the other (Laurent, 2014). They highlight lost *objets* which only exist as negativities since they did not exist as positive representations in symbolic-imaginary totality (Zupančič, 2017). To avoid excessive complexity, this paper will mainly consider the concept of *objet a* as a subtraction (negative excess) and will not detail these bodily coordinates.

To sum up, the real refers to the primordial loss, without (indeed, beyond) representation or signification. At birth, there is primordial organic discord (the barred corporo-real) of the internal bodily fragmentation. The infant's turn to the imaginary register introduces the gestalt ego. Perceptual and motor mastery in relationship to the external world alienates the subject from its internal experience. Language is ambiguous, and signifiers introduce enigmatic meaning and desire. Furthermore, the symbolic structures social relationships among subjects and tames the drive. Together, the symbolic and imaginary constitute the external world. Neither captures the real, since neither language nor image can represent the not-whole (Johnston, 2019; Verhaeghe, 2004). Indeed, the real insists as negative excess, the impasse of symbolic-imaginary reality.

In his integration of mathematics and knot theory, Lacan (1975–1976) describes the three registers as "knotted" together in the Borromean knot. Without going into further detail on this aspect of Lacan's thought, it suffices to say that, in his view, no register will be encountered in isolation – they intersect. This paper asserts that the brain is a critical locus of this knotting.

Mind and brain: dynamic localization

Dual-aspect monism is the philosophical basis for neuropsychoanalysis. In this view, the mind and the brain

are two perspectives of the same mental apparatus, the same thing in nature (Solms, 2015). Freud (1900, 1915c, 1923) developed different models of the mental apparatus as understood from the perspective of psychoanalysis. Within the view of dual-aspect monism, neuroscience takes an alternative route of investigating models of the same mental apparatus. As two different ways of experiencing the same thing, psychoanalysis and neuroscience each contribute a unique perspective. Neuropsychoanalysis investigates how these two perspectives overlap. Concepts from each discipline can be correlated with, but not reduced to, concepts from the other. For example, the psychological effects of brain lesions cannot be understood without knowledge of the patient's subjective history. The psychic sphere remains essential to psychological understanding. In this view, the brain *does not cause* the mind. Mind and brain are two (incomplete) lenses of the same thing in nature – changes to this thing can be investigated from both perspectives independently. Neither perspective gives a complete understanding, but consideration of both paints a more thorough picture (Solms, 2015).

Neuropsychoanalysis frames this overlap through dynamic localization (Kaplan-Solms & Solms, 2002). Psychic phenomena are not localized *in* neural structures. Instead, out of inter-activation of several neural centers, mental functions emerge *between* neural structures. A neural structure has its own function, but also contributes to the organization of others. Mental functions – and neural structures – are interdependent, such that one cannot be damaged without dynamic changes to the rest of the organization.

Thus, following a brain lesion, psychic functions are not destroyed – as in cognitive neuropsychological models (e.g. Caramazza & Coltheart, 2006). Rather, several mental functions are distorted in dynamic ways. Through psychoanalytic investigation of lesion patients, one can identify the mechanism impaired in each psychic system – the damaged neural area would be necessary for that common underlying function. This methodology (called clinico-anatomical correlation) allows a psychoanalytic mapping of the brain (Kaplan-Solms & Solms, 2002).

In this view, psychoanalytic concepts, like Lacan's registers, are not equated to neuroanatomy in a one-to-one correspondence. Instead, they are dynamically localized, reflecting a particular organization between constellations of neural activity. Inter-relations between structures prevent the reduction of a concept to a single neural explanation. Thus, I suggest that, as we look towards making some preliminary linkages between brain function and Lacan's registers, we will find that given neural areas are likely to participate to some extent in all three registers, not one in isolation. However, dynamic localization can identify neural areas which are necessary (but not sufficient) for the proper functioning of a given register.

Prior approaches to Lacanian neuropsychoanalysis

It is beyond the scope of this paper to review prior models of Lacanian neuropsychoanalysis, namely the work of Ansermet and Magistretti (2007) and Johnston (2013a, 2013b). It will suffice to highlight the differences between the present model and Ansermet and Magistretti's approach, as well as how Johnston's model lays groundwork which I build upon.

Neuroplastic traces

Ansermet and Magistretti (2007) emphasize the neuroplasticity of traces – modifications of the synaptic connections among neurons. Experience leaves a trace, whether from the external world as a sensory impression or from the internal body as a somatic marker (Damasio, 2005). However, these traces are not static. Via neuroplasticity, traces are constantly re-associated, strengthened, or weakened according to the principles of synaptic memory (Milner, Squire, & Kandel, 1998). Simply put, neurons that fire together wire together (Hebb, 1949). The network of traces changes based on experience.

However, traces are not faithful to experience. Because of neuroplasticity, the neural system of traces continues to modify itself in relation to other stimuli (internal and external) which may or may not be related to the original experience. Indeed, the laying down of traces is affected by the already-present internal organization of traces. Thus, the internal (neural) trace of experience does not bear a one-to-one relationship with the (external) experience (Laurent, 2014).

Ansermet and Magistretti's (2007) Lacanian reading of traces concludes that traces function like signifiers. Like the signifier's non-relation to the signified, traces have no clear relation to experience (due to neuroplasticity). Each brain's unique system of traces constitutes the subject's internal unconscious reality. This is how the authors interpret Lacan's (1978) claim that the unconscious is structured like a language.

To some extent, the neuroplasticity of traces reflects primary process operations. Ansermet and Magistretti discuss the reorganization of traces under the associative logic of displacement and condensation (and the Lacanian reframing of metonymy and metaphor). I argue that the basic organization of neural traces obeys this

primary process logic, particularly in the infantile brain. However, as neocortical areas mature and impose top-down regulation over lower systems (see below), the organization of traces might become more structued (at least in some areas), reflecting the secondary processes. In certain areas, primary process functions will persist; other areas may be more "bound" by secondary processes.[6] It is important to distinguish between the function of traces in different areas of the brain.

While I agree with Ansermet and Magistretti's model of traces, I believe their argument misses the Lacanian distinction between the three registers. Each register would have its own traces in neural structures. Ansertmet and Magistretti's model does not discern the differences between traces at these registers (e.g. the difference between the traces of the image in the mirror and those of the name given to that image). Moreover, their reading of the unconscious as internal reality aligns more with Lacan's formations of the unconscious (through the symbolic) and fantasy, rather than the non-representational navel of the unconscious as the real.

The "rotten" brain

In his discussion of the drive, Johnston (2013a) highlights two "axes": alteration and iteration. Alteration refers to the shifting aims and objects of the drive, which are not inherent. This involves the symbolic and imaginary (dis)junctions with the real. Iteration refers to the source and pressure of the drive as a repeating non-representational demand upon the mind.

Therefore, Johnston (2013a) describes drive itself as being split between alteration (symbolic-imaginary aims and objects) and iteration (barred coporo-real source and pressure). It is self-defeating, since non-representational iteration demands the eternal return of the same, something impossible for the aim and object. In his words: "the very attempt at representational repetition made by the axis of alteration at the behest of its corresponding axis of iteration itself generates repetition-defying differences." Thus, "the split within the very structure of [drive] is temporal," where iteration and alteration are characterized by a temporal tension (p. 61).

In other words, there is a temporal disjunction between the barred corporo-real and the symbolic-imgainary registers. The real is an *a priori* "rotten nature." Insofar as Lacan situates drive in the real, drive's inherent structure is a failure (Johnston, 2012). It is a failure of total satisfaction, of filling in the lack – because the real does not obey the logic of a lack which can be filled. It is "rotten" insofar as its nature is not in totalizing harmony with itself; rather, there is an inherent antagonism, impasse, or disjunction. The real of the drive stands for this antagonism within nature. Johnston (2013a) localizes this "rotten" nature to the structural disjunctures of the brain itself. Damasio (2010) and LeDoux (2002) comment on the evolutionary hodgpodge of systems in the brain. Drawing on Linden's (2008) view of the brain as a "kludge," Johnston emphasizes that the brain did not evolve as a totality. Rather than a unified, harmonious system, the brain is a series of systems which evolved on top of each other and whose functions can conflict. Ancient emotional systems shared across mammals (Panksepp, 1998) sit together in an uncomfortable "kludge" with evolutionarily-recent neocortical structures relatively unique to humans (Damasio, 2010). These structural failings open a neurobiological basis for a brain divided by the barred corporo-real – an original, antagonistic split.

Johnston (2013a) argues that the real (drive iteration) corresponds to non-representational emotional-motivational subcortical systems, whereas the symbolic and imaginary (drive alteration) correspond to neocortical representational systems. These registers intersect, for "the cerebral cortex, via the thalamus, is the conduit for the phenomena and structures of Imaginary-Symbolic reality to affect and mediate the bodily Real, embodied first and foremost in the brain stem" (Johnston, 2015, p. 62).

From Johnston's Lacanian neuropsychoanalysis, I draw upon his understanding of the brain as "rotten," with an internal antagonism inherent to its "natural" structure. I also highlight his emphasis on the temporal split in the drive. Since the two axes of the drive involve participation of all three registers, this temporal split also rifts the symbolic-imaginary and the real. Furthermore, against Lacan's anti-evolutionary stance, Johnston (2012) calls for a phylogenetic account of the emergence of this neural disjuncture which characterizes humans. One might place Johnston's call for a neuropsychoanalysis that reckons with the temporal tension of the drive at both the ontogenetic and phylogenetic levels.

The present Lacanian meta-neuropsychology maps Johnston's localization of the three registers in greater detail, particularly through dialog with Mark Solms' Freudian meta-neuropsychology (Kaplan-Solms & Solms, 2002; Solms, 2013, 2017b). Furthermore, it introduces a developmental perspective to dynamically and *temporally* localize the disjuncture between the real and the symbolic-imaginary. Mapping at the level of neural centers (as opposed to Ansermet and Magistretti's synaptic traces) allows a better localization of Lacan's registers for a more nuanced meta-neuropsychology of the subject.

Tying the brain in a Borromean knot

As a prelude to this meta-neuropsychology, recall that Freud (1923) posited two "surfaces" for the mental apparatus. On one hand, the ego is turned towards the external world via the perceptual modalities. On the other, the id is turned towards the internal milieu and receives stimuli from the body (i.e. the drives). This division maps easily onto the brain. Perceptual cortical structures receive external information via the sensory modalities whereas upper brainstem structures receive input from the internal body (Solms, 2013).

A Lacanian reading of Freud's division between ego and id highlights the internal otherness of the subject, the "s" of "subject" being a homophone with "*Es*," the German word for "it," translated in the *Standard Edition* as "id." (Lacan, 1977). Building on Johnston (2013a), I suggest that the upper brainstem representations of the internal body refer to an "extimate," internal otherness, the alien real (Lacan, 1997). These subcortical structures are present from birth, whereas the more experience-dependent neocortex is developmentally delayed (Solms & Turnbull, 2002). I believe this developmental time lag contributes to the temporal split and the insistance of the real from infancy. Areas corresponding to the real (which, as will be discussed, are largely affective and non-representational) lay down memories prior to the subject's capacity for (imaginary) episodic representations or its ability to speak.

Therefore, I argue that the evidence suggests that the division between the upper brainstem id (the real) and the cortical ego (symbolic-imaginary) is multi-fold: phylogenetically structural (evolutionarily ancient brainstem versus recent neocortex), qualitative (non-representational, emotional dynamics versus imaginal, linguistic representations), and ontogenetically temporal (innate and active from infancy versus developmentally delayed).

In this meta-neuropsychology, one must keep in mind the principle of dynamic localization. It is incorrect to say that any of Lacan's registers are *located in* or *equal to* brain structures. Psychic functions emerge *between* neural structures. This is especially relevant for the cortical localizations of the symbolic and imaginary. Elements of all three registers will be found at every level of the brain. However, this does not prevent a dynamic localization of which areas appear *essential* to the "typical" functioning of each of these registers. It is to this dynamic localization that I turn now.

Affective consciousness and the real

Recall the concept of the real as a negativity (non-representational insistence) which is present from the beginning. *Das Ding* emerges simultaneously with understanding yet is outside of it (Freud, 1895). Reason (or cognition, understood as a symbolic-imaginary function) cannot represent, and thereby cannot comprehend, the real. In this way, the limit of reason is *within* reason (Copjec, 2012; Laplanche, 2011).

Therefore, neural areas corresponding to the real should be constitutive of, but not identical with, cognitive functions. As non-representational, they should insist their presence through affect and the compulsive repetition of the drive. At the core of the subject, the real is also at the core of cognition, while simultaneously the limit of that cognition.

The drive (iteration, source/pressure) refers to the real (Johnston, 2013a). Freud (1915a) defined drive as:

> a concept on the frontier between the mental and the somatic, as the psychical representative of stimuli originating from within the organism and reaching the mind, as a measure of the demand made upon the mind for work in consequence of its connection with the body. (Freud, 1915a, pp. 121–122)

Drive, thereby, refers to the demand upon the mind concerning bodily needs. In the brain, the brainstem and diencephalon contain "need-detectors." Each has a homeostatic set-point – for example, the ideal amount of salt to have in the blood. The hypothalamus and related systems closely monitor and modulate the internal body (see, for example, Waterson & Horvath, 2015; Williams, Harrold, & Cutler, 2000; Woods, Seeley, Porte, & Schwartz, 1998). These areas can be dynamically localized as important points of proximity between the body and the mind, and the locus of the pressure of the drive (Solms, 2013).

These diencephalic and upper brainstem systems are fundamentally affective (Panksepp, 1998; Solms, 2013). Deviations from set-points produce unpleasure, whereas moving towards the set-point generates pleasure. One major structure is the periaqueductal gray (PAG), which receives projections from these brainstem areas. Stimulation of the ventral columns of the PAG induces feelings of extreme pleasure, whereas stimulation of the dorsal columns corresponds to feelings of excruciating pain. Here, one finds the pleasure principle as a key dynamic in the process of maintaining homeostasis (Solms & Turnbull, 2002).

Importantly, this affective system is fundamental to consciousness, the feeling state of being. Disturbances to upper areas of the brain disrupt cognitive and emotional functions, but the subject retains affective being (Penfield & Jasper, 1954). For example, hydranencephalic patients are born with little-to-no cortex but intact subcortical affective circuits (Merker, 2007;

Shewmon, Holmes, & Byrne, 1999). These patients are still conscious in the affective sense and respond to the environment through these circuits. Summarizing these various lines of evidence, Solms (2013) argues that consciousness can exist without cortex.

However, damage to these affective circuits significantly impairs consciousness (along with cognition). In fact, a lesion to the PAG completely wipes out consciousness, extinguishing affective being. This supports the critical role of the upper brainstem in the generation of consciousness (Moruzzi & Magoun, 1949), which leads Solms (2013) to conclude that affective consciousness is the bedrock of consciousness. Later cognitive functions of the cortex depend upon *and are shaped by* the affective circuits which function prior to them (Panksepp, 1998; Solms & Turnbull, 2002).

With its (extimate) relationship with the internal body via homeostasis and drives, the upper brainstem and associated structures correspond functionally to Freud's id. In contrast, the cortical focus on exteroception corresponds to Freud's ego. Since the upper brainstem is intrinsically conscious (i.e. its activity generates the affective bedrock of consciousness) and the cortex is dependent on the brainstem for consciousness, Solms (2013) argues that the id is fundamentally conscious. Rather than the nucleus of the unconscious, the id is the font of consciousness.

More specifically, the id (upper brainstem and associated structures) is *affectively* conscious. It generates *being* as a feeling state *without* representation. Through a Lacanian lens, this affective consciousness corresponds to the *insistence* of the real. It is non-representational, a primary affect (Lacan, 1997). It is beyond (indeed, prior to) cognition – constituting a limit, an impasse. Furthermore, as the bedrock of consciousness, it is constitutive of cognition. This fits well within Lacan's conception of the real and the drive (Johnston, 2013a).

Affective instincts

Additionally, affective consciousness extends into the limbic system. Panksepp (1998) identifies seven affective systems: SEEKING, RAGE, PANIC, PLAY, CARE, LUST, and FEAR.[7] Across mammals, they exhibit the same circuitry, neurotransmitters, and stereotyped motor functions (see Panksepp, 1998 for neuroanatomical details). A combination of lesion, pharmacological, and deep brain stimulation studies supports the dynamic localization of their functions.

SEEKING closely resembles the Freudian libidinal drive (Solms, 2012a). It is an *objectless*, volitional system that carries its own subjective quality of *excitatory* pleasure (as opposed to a reduction of tension). The rest of the circuits are more specialized. For example, RAGE characterizes the aggressive impulse to destroy that which frustrates the subject's goals. PANIC activates in response to separation from a loved object, connoting separation-anxiety. Generally speaking, all seven systems generate a distinct response to an experience of the external world.

Furthermore, these experiences also concern socio-emotional needs, such as attachment needs in the PANIC system (Solms, 2012b). These limbic circuits qualitatively elaborate upper brainstem affective consciousness through distinct socio-emotional needs. These affective instincts prepare the organism to interact with the world and meet its needs, albeit in a rough-and-ready way (Solms & Turnbull, 2002).

Insofar as these affective instincts are prepared for certain types of experiences, I would suggest that they are not the real proper and are better localized at the intersection of the real and the imaginary. Nevertheless, they also have built in "holes" – the potential to acquire new objects. For example, the FEAR system has certain built-in objects (such as a fear of falling). However, it also has the potential to learn new objects, such as electrical outlets. This potential is never exhausted, for these areas are subject to neuroplasticity (Ansermet & Magistretti, 2007; Solms & Turnbull, 2002). I suggest that these seven affective instincts might be considered "highways" from the real to the symbolic-imaginary. Similarly, Verhaeghe (2004) highlights Panksepp's (1998) instincts as potential neurobiological underpinnings in the child's turn to the Other (symbolic-imaginary registers) to answer the pressure of the drive (the real).

These instincts contrast with the upper brainstem homeostatic drives. Each instinct represents a socio-emotional need. In the perspective of drive as representative of bodily need (i.e. located in brainstem and diencephalon "need-detectors"), there is not much flexibility in terms of what objects might satisfy the drive. Only water can satisfy the demand made upon the mind when dehydrated, for example. However, affective instincts are more flexible – emotional needs may find any number of objects.

Therefore, the flexibility attributed to the psychoanalytic drive (i.e. alteration, the aim and object) corresponds with the plasticity and potentiality of these affective instincts. In contrast, the brainstem, corresponds to the real of the drive (i.e. iteration, the source and pressure). Indeed, drive itself is split – here, neuro-structurally and evolutionarily, for the affective instincts are more evolutionarily recent than the upper brainstem (Solms & Turnbull, 2002). For Lacan, the tension of the drive is never eliminated. SEEKING corresponds best to this notion of excitatory pleasure in the drive, for it is innately *objectless*

(Solms, 2012a). However, this inexhaustibility may be attributed to all seven affective instincts.

The temporal split

Furthermore, these affective instincts are active from birth, before the capacity to lay down episodic memories (declarative memories which the subject can recall, imagine, and verbalize). In addition, procedural memory systems, including the basal ganglia,[8] mature very early in life (Richmond & Nelson, 2007), and there is evidence for procedural memory (e.g. simple conditioning) in newborn infants (DeCasper & Fifer, 1980). In contrast, the hippocampus, a limbic structure necessary for episodic (representational) memories does not mature until around the age of three (Solms & Turnbull, 2002). Because of this temporal difference between declarative memory (belated hippocampal and neocortical development) and non-declarative memory (affective instincts and basal ganglia), memories during the first few years are laid down which can *never* be explicitly remembered – they were not laid down as representations (in declarative memory). There are no declarative representations of these early infantile experiences.

The capacity for learning in these procedural and emotional systems suggests that these early infantile experiences are encoded in the brain and play a significant role in subsequent development. Since a great deal of non-declarative learning occurs in infancy, automatization will cause such memories to persist throughout life (Solms, 2017a, 2017b). After the development of hippocampal memory systems, one may recall specific experiences (although, early childhood memories would likely be murky). However, the prior, infantile experiences – solely encoded in non-representational procedural and emotional memory – continue to exert pressure and generate affect if needs are unmet (Solms, 2017a).

Therefore, I suggest that the brainstem and subcortical affective circuits are *necessary* structures underpinning the Lacanian real. They are not *sufficient*, since other areas, such as the insula (Magistretti & Ansermet, 2012), may also play critical roles. These systems refer to the unspeakable aspect of being. Experiences laid down in infancy *cannot* be remembered or represented to the subject, but they continue to be affectively felt. Lacan (1993) highlights Freud's emphasis that primary repression (the real) refers to the era of infantile relations for which speech is impossible. This is the *insistence* of the real which cannot be represented but is nevertheless present as negativity. Furthermore, this insistence occurs through compulsive repetition (automatization) of these systems. Like the upper brainstem drives, these automatized, non-representational infantile memories are foundational for (constitutive of) and inaccessible to (the limit of) later cognition (Solms & Turnbull, 2002). As such, they belong to the real.

Such dynamics apply to all experiences coded in this non-representational manner, which can occur after infancy. In PTSD, for example, heightened cortisol levels can shut down hippocampal function and enhance amygdala function – the latter involved in FEAR and RAGE. Sole amygdala encoding of the event lays the memory down in a non-representational *but still felt* form (Ansermet & Magistretti, 2007; McGaugh, 2000). Research indicating the *bodily* (non-verbalized) encoding of the trauma (van der Kolk, 2014) supports the real dimension of these traces and their connection to the body(-in-pieces). This corresponds with Lacan's notion that the real is traumatic, without language (Lacan, 1978).

Moreover, this neuropsychoanalytic model nuances the affective angle of the real. Since each instinct runs through the PAG, each has its own homeostatic system of pleasure-unpleasure. Rather than a single pleasure-unpleasure series, there are multiple circuits of pleasure and unpleasure. What is pleasurable for one instinct can be unpleasurable for another, creating potential for conflict (Solms & Turnbull, 2002). Furthermore, what was once pleasurable may not have the same result in the future (cf. the temporal split; see also Bazan & Detandt, 2013).

Thus, I suggest a different relationship between the repetition compulsion and the pleasure principle. With multiple instincts, there are multiple series of pleasure-unpleasure. Because they are automatized in non-declarative memory, each instinct functions under its own compulsion to repeat, particularly with respect to early infantile memories. Although the environment may change, these automatized instinctual responses may repeat, even if they cause unpleasure in the present (Solms, 2017b). When the compulsively repeated instinctual function was first encoded, it had initially served homeostasis.

Therefore, unpleasurable repetition is not "beyond" the pleasure principle as a completely distinct system or drive. Rather, it is the repetition (insistence) of a prior function of the pleasure principle – a solution which was previously automatized (obeying the pleasure principle) but whose repetition in the present no longer brings pleasure (violating the pleasure principle).[9] Homeostatic repetition of these circuits assists the survival of the subject (thereby felt as pleasure). This might be considered "healthy" repression because the automatized emotional response meets the subject's needs (Solms, 2017b). Unpleasurable repetition may be

thought of as arising from an automatized response that was once in the service of homeostasis for the subject but is now no longer adaptive. From a Lacanian standpoint, Bazan and Detandt (2013, 2017) make a similar argument for the SEEKING system, linking its automatized repetitions to the drive as (potentially) maladaptive excess. The model proposed in this paper extends this logic to all procedural-emotional systems.

While the real can be dynamically localized from the perspective of the brain (cf. dual-aspect monism), the mind can never localize (represent) its own affective consciousness. Indeed, neuroimaging would reveal nothing about the specific experience of these circuits and their memories. In the physical world, one may localize the real while maintaining that it is a non-place in the psychical sphere.

In dialog with Lacan, affective consciousness, the core of consciousness, is simultaneously alien to consciousness. It is an internal, "extimate" presence of affect at the base of the mind's relationship to the body, representative of something foreign to the subject. Such an internal exteriority stands at a disjuncture with respect to the symbolic and imaginary structures of the cortex.

Cracking the cortical mirror

At several points, Lacan claims that the cerebral cortex functions as an "intra-organic mirror" (Lacan, 1977; Lacan, 1988, p. 80). Certain parts of the cortex participate in this imaginary function. Recall that the imaginary constitutes the basis of a cohesive self-representation (the ego) derived from perception of the external world. This contains the partial drives, creating an illusory cover over the gap of the real. Therefore, damage to areas which are fundamental to this function would predict a fragmentation of the ego. Such damage would unravel the partial drives and increase the intrusion of the real.

Neuropsychological research suggests that the right hemisphere is essential to ego-centric body constitution (Morin et al., 2003). Right hemisphere damage can lead to symptoms breaking down the subject's perceptual and motor relationship to the external world, as well as fragmentations of the self (Kaplan-Solms & Solms, 2002).

Damage to the parietal lobes, predominantly in the left but also in the right,[10] may cause apraxia, an impairment in motor function and imitation without a primary deficit in motor control (Goldenberg, 2009). Hemineglect is also associated with right parietal damage – patients systematically neglect the left side of space, without any primary deficit in perception. This neglect extends beyond concrete perception of the external world to internal representations and mental images (Guariglia, Palermo, Piccardi, Iaria, & Incoccia, 2013). Bilateral parietal damage may result in Bálint's syndrome (Ptak & Fellrath, 2014). These patients are impaired in visually-guided reaching, have uncoordinated eye movements, and cannot attend to more than one object at a time. Altogether, these syndromes suggest deficits in the subject's motor and perceptual relation to the external world – a relationship which Lacan (1988) identifies with the imaginary register.

Neuropsychoanalytic investigations (Feinberg, 2010; Fotopoulou, 2015; Fotopoulou, Pernigo, Maeda, Rudd, & Kopelman, 2010; Kaplan-Solms & Solms, 2002; Salas & Coetzer, 2015) have elaborated the subjective, emotional features of right hemisphere (often in the perisylvian area) damage. Anosognosia for hemiplegia is the denial of paralysis. When confronted with clear evidence of paralysis, patients might say that the arm is not theirs or that it belongs to the doctor. Variations include anosodiaphoria, where patients do not deny the deficit but remain (manifestly) emotionally indifferent, and misoplegia, an obsessional hatred of the paralyzed limb (Solms, 2015).

Reconciling these extreme emotional presentations (unawareness, indifference, and hatred) following damage to similar areas of the cortex, Kaplan-Solms and Solms (2002) suggest a regression to narcissistic defenses and a breakdown of whole-object relations. The ambivalent nature of the subject's relationship to objects is unraveled, resulting in splitting[11] into good and bad part-objects along with drive defusion.

This paradigm aligns the splitting of object relations with the breakdown of the perception of the external world. The parietal lobes integrate different sensory systems for a holistic representation of the external world (Matheson & McMullen, 2010; Milner & Goodale, 2008). As this processs breaks down, the ego is simultaneously fragmented – parts of the body are treated as other. As the internalized representations of the whole-object world collapse following right hemisphere damage, whole-object relations break down into part-object relations, a splitting of the ego (Kaplan-Solms & Solms, 2002).

From a Lacanian lens, Morin (2018) comes to a similar conclusion, where there is a breakdown in the relationship between the *objet* and the ego. When asked to draw self-portraits, right hemisphere patients depict a fragmented body-image that reflects subjective changes in the relationship to the body. One patient commented: "I have members, but I have no body which obeys me" (Morin et al., 2003, p. 26). Many of these patients' self-portraits *did not* accurately depict the state of the body and the subject's life, signifying a breakdown in the ego where the foreigness of the body emerges.

Whereas Kaplan-Solms and Solms (2002) use a Kleinian reading of whole- and part-objects, Morin (2018) interprets bodily delusions as the intrusion of the Lacanian *objet a*. Rather than excessive secondary repression (Solms' denial of paralysis), Morin interprets a lifting of primary repression of *objet a*. I will return to this difference between Morin and Solms towards the end of this paper. For now, recall that the imaginary typically covers the real by obfuscating the fragmented partial drives. It follows that impairments to the imaginary involve the intrusion of the real. This does not prevent the neurological patient from utilizing remaining defenses, such as denial.

Therefore, I suggest that damage to the right hemisphere[12] "cracks" the cortical mirror. Its functions do not disappear – there are still relations to the external world. The regression from whole- to part-object relations accords with Lacan's hypothesis that the cortical mirror binds partial drives (Vanheule, 2011). Also, Kaplan-Solms' and Solms' (2002) focus on changes in Kleinian object relations following right hemisphere damage supports Lacan's (1988) argument that object relations belong to the imaginary register.

Moreover, the symptoms of hemi-neglect and apraxia show how right hemisphere damage simultaneously impairs the subject's representation of external reality (of space and of others). That distortions of both external space *and* the ego coincide in right hemisphere damage supports Lacan's (1988) connection between the imaginary internalization of the ego and the constitution of external perceptual reality. Importantly, primary perceptual processes (i.e. vision, audition, somatosenation, olfaction, and gustation) are still intact following right hemisphere damage – it is the the integration (wholeness) of these senses which is impaired.

Therefore, right hemisphere damage *distorts* the totalizing function of the imaginary. Since imaginary functions remain (albeit in a distorted fashion), the right hemisphere is thereby *necessary* but not *sufficient* for "typical" imaginary functions, particularly the gestalt ego. This supports the principle of dynamic localiation against a bio-reduction of the imaginary to this hemisphere.

Inscribing signifiers

Recall Lacan's emphasis on the symbolic (language) in structuring the subject through enigmatic signifiers. This suggests a linguistic organization of signifiers in the brain independent from, but still connected to, semantic meaning. Symbolic brain areas would thereby underlie meaning, structuring the subject's external (imaginary) experience of reality (Ribolsi, Feyaerts, & Vanheule, 2015). Since Lacan extends the symbolic from language to law, these neural areas will also represent and implement abstract social rules.

Neuropsychological and cognitive neuroscience research inscribes signifiers in a left hemisphere network, largely temporo-parietal (Binder & Desai, 2011; McGilchrist, 2009; Price, Moore, Humphreys, & Wise, 1997; Rapcsak et al., 2009). Left hemisphere damage often results in aphasias, disorders of language. Damage to the left inferior frontal gyrus (Broca's area) results in Broca's aphasia. Broca's aphasics cannot articulate words, and speech becomes non-fluent. However, psychoanalytic investigations suggest that the structural integrity of the psyche remains intact (Kaplan-Solms & Solms, 2002). There are no dramatic changes in personality or significant cognitive deficits, beyond errors in complex syntax comprehension. In other words, the motor output of language (the articulation of a certain signification) is damaged without impairment to internal symbolic organization. These patients can therefore understand spoken and written language (Kaplan-Solms & Solms, 2002).

In contrast, damage to superior posterior temporal cortex results in Wernicke's aphasia, an impaired comprehension of language. Kaplan-Solms and Solms (2002) argue that damage here impairs the association between words and things. Hearing is intact, but meaning cannot be attached to words. Speech remains fluid but lacks any coherent meaning.

However, these patients also retain executive control and remain more-or-less oriented to reality. Impaired audio-verbal reflexive consciousness (i.e. the rupture between words and things) results in some lapses of personal continuity,[13] but these do not dominate experience.[14] Therefore, the connection between signifiers and semantics contributes to subjective structure, but it is not the essential organizing principle. Behavioral and executive control (ego functions) endure. These patients (and Broca's aphasics) can undergo the normal process of mourning, reflecting intact psychic organization (Kaplan-Solms & Solms, 2002).

This contrasts with more extensive left parietal damage leading to transcortical aphasia, which significantly impairs the patient's ability to think. Kaplan-Solms and Solms (2002) argue that the convergence of sensory tracts in left parietal cortex is a re-representation of sensory data in an abstract, symbolic form. Associative links are formed between symbolic concepts in the left parietal lobe.

In Lacanian terms, one might understand damage to this area as a significant blow to the signifying (associative) chain. Damage to abstract levels of symbolic associations impairs the constitution of meaning. Words with

rudimentary associative links (e.g. "trigonometry," "geometry") come to mind without being linked to meaning (Kaplan-Solms & Solms, 2002). Greater symbolic abstractions are destroyed. Without abstract associative links, subjective experience loses the structure given to it by language – signifiers passively occur to the subject without any sense of meaning. This meets the prediction that damage to the signifying chain itself will undermine the sense of meaning.

In sum, evidence suggests that left hemisphere disruptions of speech production (Broca's aphasia) or comprehension (Wernicke's aphasia) do not undermine the structural integrity of the psyche, whereas damage to the abstract links between symbolic concepts significantly impairs thinking and meaning-making. This supports Lacan's emphasis on the signifying chain for structuring the subject. I argue that the linguistic materiality of the symbolic (the signifiers of language) is largely inscribed in the left temporo-parietal cortex. However, the symbolic is more than simply speaking and comprehending words, or even abstract concepts. Via the symbolic, the subject takes a *position* in language – that is, a position with respect to the Other and with respect to negativity (Lacan, 2007; Verhaeghe, 2004; Zupančič, 2017). In Lacanian neuropsychoanalytic terms, the symbolic entails social regulation among subjects and the modulation of affective consciousness.

Rules and regulations: the cortical law

Symbolic functioning effects a degree of organization, of structure. Psychological research suggests that mind's linguistic framework of sounds (phonetics) and meanings (semantics) has an associational structure (Collins & Loftus, 1988; Kahan, Sellinger, & Broman-Fulks, 2006). When a word is activated (e.g. in speech), other words similar in sound and meaning are also activated. This can be seen in priming effects (i.e. rapid presentation of a stimulus – in this case, a word) which decrease response times for associatively related target words. Bazan (2011) discusses the necessary inhibition of irrelevant associative links to make sense of speech. For example, if one meaning of a word is disambiguated (e.g. "match" in the context of lighting fire), then comprehension of the word with a different meaning is delayed (e.g. "match" as in a game). The left prefrontal cortex (PFC) performs this inhibition in the service of articulating a particular meaning (McGilchrist, 2009).

The PFC executes an internalized abstract rule system, selecting proper actions (and inhibiting undesired ones) based on the current social rules (Badre, Kayser, & D'Esposito, 2010). With input from association cortex (such as parietal lobes where the imaginary and signifiers are mediated), the PFC exerts organizational control over the rest of the brain. For example, aging populations with diminished prefrontal functions show more errors in remembering the order of items and make more mistakes when asked when and where something was learned (Roediger & Geraci, 2007). Damage to PFC can produce similar effects, sometimes called frontal amnesia (Baddeley & Barbara, 1988; Schachter, 1987). Frontal amnesia is not a deficit in memory contents *per se*, but rather in the organization of memory. The PFC also underlies the subject's ability to mentalize action and bring representations to (self-reflective) consciousness through working memory (Baddeley, 2003). In other words, prefrontal functions *structure* mental contents and experience.

Thereby, the PFC fundamentally mediates symbolic *executive organization*. Through rule systems, the prefrontal lobes control behavior and speech. For instance, executive control of phonological short-term memory supports sentence comprehension and structure (Willis & Gathercole, 2001). PFC receives and organizes input to serve the current social goal or rule (Baddeley, 2003; Badre et al., 2010). This introduces the social dimension of the symbolic.

Kaplan-Solms and Solms (2002) argue that the ventromedial PFC performs the ego's function of binding cathectic energy, enabling Freudian secondary processes. Damage here results in the emergence of timelessness, mutual contradiction, and an emphasis on psychic reality. Such damage reveals the dominance of unconscious functions (i.e. the system unconscious; Freud, 1915c) in patients with ventromedial prefrontal damage. They act impulsively, without regard for social convention (Solms & Turnbull, 2002). Kaplan-Solms and Solms (2002) describe this as an unraveling of the fabric of the ego (Kaplan-Solms & Solms, 2002).

Where they use the term "ego," I believe Lacan would use "subject," since Kaplan-Solms and Solms (2002) are not referring the concrete, ideal image of the self (the ideal ego), but rather to the structure of the psyche with respect to others and the unconscious. In Lacanian terms, these patients reveal major deficits in the symbolic, in relation to the common cultural Other (disregard for social rules) and the real (dysregulation of drives). In support of this interpretation, ventromedial PFC receives input from limbic circuits (affective systems) and "binds" this energy, organizing it based on the subject's social milieu and history (Solms & Turnbull, 2002). In infancy, parental figures organize and socialize the child's experience. PFC internalizes actions and speech – especially of the parents – in order to organize experience and control behavior (Kaplan-Solms & Solms, 2002) This fits with Lacan's placing the parents in the position of the Other

who exerts symbolic law to regulate libidinal desires of the subject (Verhaeghe, 2004).

The ventromedial areas communicate socially modified affective information to the dorsolateral PFC, which determines the best course of action based on the abstract (social) rule system in play. I suggest that, given this correlation, it is reasonable to propose that expressed desire (i.e. desire filtered through the Other, internalized in PFC) involves a split between subcortical drive pressures and cortical, socio-linguistic rules and words which originate in the Other. Self-conscious representational thinking (working memory), a feature of the imaginary ego, depends on the prefrontal binding of subcortical drive pressures (Kaplan-Solms & Solms, 2002). This follows Lacan's (1993) assertion of the imaginary's dependence on the symbolic for structure.

Therefore, I propose that the PFC is a major locus of the convergence of the signifying chain of language, affective needs, and the imaginary external world. Social rules (symbolic) and self-reflection (imaginary) regulate the pressure of the real. While underlying significant symbolic structure, this region constitutes an intersection of all three registers.

The Borromean brain

To summarize, based on the very preliminary correlations between brain function and Lacanian ideas laid out in this paper, I believe that we can make a first pass at localizing Lacan's registers as follows. The real, corresponding to the barred-corporeality of the subject, emerges first and foremost in the upper brainstem representatives of bodily needs. This non-representative pressure motivates subcortical limbic and basal ganglia systems at the interface of the real with the symbolic-imaginary registers. Prior to hippocampal (episodic, representational) memory, these emotional memories are encoded in a real fashion, insofar as they insist a non-representable, affective pressure upon the subject.

The right hemisphere appears to be a key locus of brain circuits underlying the constitution of the ego as a gestalt, thereby serving as the foundation for the imaginary register. Partial drives are (not fully) unified through the right hemisphere to enable whole-object relationships. In the left temporo-parietal cortices, the abstract signifying chain is constituted, providing structure for the subject. The PFC extends the symbolic through the internalized Other (parents) which sets rules which organize speech and actions. Imaginary experience of motor mastery and active representational memory (i.e. working memory) are also supported by the PFC.

However, in keeping with the principle of dynamic localization, there is no clean division between the registers as subcortical real, left hemisphere symbolic, and right hemisphere imaginary. The neuropsychological evidence discussed above supports the argument that these areas are *necessary* but not *sufficient* for the typical functioning of these registers.

For example, Morin (2018) analyzes her right hemisphere patients through the concept of the body schema. This refers to the imaginary gestalt ego, its function to cover the real, and its symbolic coordinates with respect to the Other. She makes use of all three registers in analyzing the right hemisphere (e.g. self-portraits, pronoun use, delusional intrusions of *objet a*). However, her conclusion of right hemisphere disorders as body schema disorders highlights the essential imaginary impairment. While the other registers are also affected, the critical blow is to the integrity of the body schema (i.e. the imaginary ego) as a unity. Subsequent effects, such as the intrusion of *objet a* and altered speech, reflect the dynamic localization of the system and effects predictable following damage to circuits mediating the imaginary.

Furthermore, Kaplan-Solms and Solms (2002) demonstrate how psychoanalytic interpretations could temporarily undo anosognosia due to right hemisphere damage. In a Lacanian framework, these interventions (via the signifier) may have reoriented the subject to its reality via the intact signifying chain, despite "cracks" in the imaginary. That these patients regressed to their previous state after some time suggests that the imaginary is necessary to maintain this orientation. Additional research (Yeates, Henwood, Gracey, & Evans, 2006) has shown that social and interpersonal relations affect the extent of disability awareness following brain damage, pointing to the dynamically localized knotting of the registers.

In particular, the left and right cortical hemispheres seem to involve extensive dynamic inter-activity for the symbolic and imaginary. McGilchrist (2009) argues that the left hemisphere mediates abstract, determinate knowledge. It expresses a particular meaning. In contrast, the right hemisphere underlies non-articulate knowledge that extends beyond what is certain. Hence, the capacity for ambiguity and metaphor are considered primarily right hemisphere functions (Ribolsi et al., 2015).

Therefore, the ambiguity of the signifier, with infinite potential meanings, seems to be a right hemisphere function. Similarly, the sonorous, phonetic aspect of the signifier, as opposed to semantic meaning (to use the Lacanian term, *lalangue*; Cottes, 2003; Johnston, 2013b), corresponds to the rhythm of language, a right hemisphere function. Indeed, non-meaningful words are prior to meaningful speech, just as the right hemisphere develops earlier than the left (McGilchrist, 2009).

On the other hand, a particular meaning (at the intersection of the symbolic and imaginary) seems to be a left hemisphere function. Thus, neither register can be cleanly reduced to one hemisphere. Rather, there is a dynamic localization (between hemispheres) of these functions.

In a similar vein, Panksepp's (1998) affective instincts differ structurally in humans compared to lower mammals (e.g. rats) (Johnston, 2018). For example, the human SEEKING system projects up the limbic system through PFC and further into other neocortical structures. Higher cognitive functions inter-weave with the SEEKING system in a more complex (and, perhaps, kludgey) fashion compared to lower mammals. Thus, the pressure of the drive as non-representational primary affect (at least prior to hippocampal development) is not reducible to subcortical areas. The SEEKING system cuts across evolutionarily ancient and recent layers of the brain, which might be further evidence for the drive itself as being split (Johnston, 2013a).

Moreover, the cortical (cognitive) and subcortical (affective) dichotomy is a false oversimplification. Rather, subcortical structures are *necessary* but not *sufficient* for human affective functions. The neuropsychological evidence demonstrates that damage to these areas significantly impairs affective processes (Solms, 2013), but not that human affect is reducible to them. Likewise, the real depends on these subcortical processes, but still exists (or, insists) in symbolic-imaginary cortical structures which affect the nature of emotion (Panksepp & Solms, 2012). Similarly, in his later teachings, Lacan (2000) focuses not on the split between the signifier and affect, which would be akin to the division between cognition and affect. Rather, he emphasizes the split *within* the signifier (Zupančič, 2017), akin to the extimacy of the real within the symbolic and the insistence of affective consciousness within self-reflective cognition.

I hope that these preliminary formulations of a Lacanian meta-neuropsychology demonstrate the possibilities for a neural convergence (but not necessarily an agreement) of different psychoanalytic schools. This follows Solms and Turnbull's (2002) call for the brain to function as a "useful set of anchor points from which to reevaluate psychoanalytic concepts" (p. 42–43). As other psychoanalytic models are mapped, the brain can provide a common ground to debate different theoretical constructs. For example, in contrast to Kaplan-Solms' and Solms' (2002) conclusion that anosognosia is due to excessive (secondary) defenses, Morin (2018) argues that anosognosia is an undoing of primary repression (hence the intrusion of *objet a*). No doubt similar debates can emerge across other neurological syndromes. As we expand our neuropsychoanalytic correlations, these kinds of debates can be clarified, and concepts enriched. Viewing the brain through different psychoanalytic lenses can thus open new avenues for dialog.

A Lacanian neuropsychoanalysis emphasizes the *disjuncture* between the symbolic-imaginary cortices and the subcortical real. Pre-hippocampal, infantile dynamics heavily influenced by drive pressures contrast with structured, neocortical processing, which originates from the Other. This is a failed relation. Johnston (2013a) paraphrases Lacan: "there is no intracerebral relationship," a play on Lacan's "there is no sexual relationship" (p. 59, translated by author). Something emerges as loss (*objet a*) in neocortical representation and interaction with the subcortical drive pressures.

This Lacanian emphasis on the extimate real complicates affective consciousness. Affect is foreign and may thereby be subject to misrecognition or "misfeeling" (Johnston, 2013b) by self-reflecting consciousness (Panksepp & Solms, 2012). A Lacanian neuropsychoanalysis emphasizes that affective consciousness is not self-evident, even to the feeling subject. Such an intracerebral impasse may be a productive way to understand Lacanian anxiety as the (negative) presence of *objet a*. On the other hand, the neuropsychoanalysis of affective instincts allows some mapping of the real with precision impossible from the subjective viewpoint of psychoanalysis. Neuropsychoanalysis is indeed a bi-directional dialog (Solms, 2015).

This preliminary meta-neuropsychology is sketched in broad brushstrokes. Lacanian studies of neurological patients (e.g. Morin, 2018) can enrich this model. As always, this integration with neuroscientific research should be tested against clinical practice. Clinical consequences of this model, such as the potential for "misfeeling" and the foreign nature of affective consciousness, can nuance (neuro)psychoanalytic practice. The analyst's counter-transference may not accurately reflect the patient's affect if affect is alien (Laurent, 2014).

Furthermore, this Lacanian meta-neuropsychology carries massive implications for neuroscience. The emphasis on the real and affective consciousness – echoing Solms (2013) – places affect at both the core and the limit of cognition. Conceiving how affective consciousness stands at a disjuncture with the neocortex (the impasse of non-representational infantile history, the body-in-pieces) is a challenge for neuroscience. Indeed, this structural negativity (impossibility) is *central* to the human being. As Johnston (2013a) suggests, the neural non-relation – "there is no intracerebral relationship" – may constitute the precisely human nature of our subjectivity and brain function.

Notes

1. For more comprehensive discussions of Lacanian concepts, see Fink (1999) and Verhaeghe (2004).
2. "Other" refers to the symbolic Other. It is the dimension of language (difference) and the pool of signifiers where meaning is articulated. The Other extends to social institutions and the law. In contrast, "other" refers to the imaginary dimension of reflexivity and sameness. This is because the ego forms by identifications with others. Otherness proper, for Lacan, is accessible through language (the Other). It is important to note that the ego is distinct from the subject; see below (Johnston, 2013b; Verhaeghe, 2004).
3. This is not to equate the unconscious with the real. Rather, the real is the nucleus of the unconscious proper (without representation). Formations of the unconscious (e.g., dreams, parapraxes) involve participation of the other registers (Johnston, 2013b). This does not contradict Lacan's statement that the unconscious is structured like a language, for the real is internal to language itself, an internal otherness (Lacan, 2007; Laurent, 2014).
4. Admittedly, this characterization of the real leaves out the essential dimension of sexuality and *jouissance*. These topics are beyond the scope of this paper and will be addressed in subsequent work. For work on the neurophysiology of *jouissance*, see Bazan and Detandt (2013).
5. In the sense of the auto-erotic drive discussed in the previous block quotation.
6. For an excellent discussion of primary processes and binding in relation to the brain, see Carhart-Harris and Friston (2010).
7. The use of capital letters follows Jaak Panksepp's usage in distinguishing the circuits from the words while also qualifying their functions.
8. Solms (2017a) localizes the unconscious (as without representation) to the automatized action plans and memories of the basal ganglia. The present paper nuances this argument by extending the unconscious (through the Lacanian real) to the insistence of the real at the level of affective instincts. Affective instincts, in their activity prior to hippocampal development, also function without representation. In this way, the unconscious is *felt* emotionally (is affectively conscious) without being cognitively (representationally, declaratively) conscious. This reflects Solms' (2013) argument that the id is conscious, in the sense that it is felt.
9. Indeed, for Lacan, the death drive is the foundation of the pleasure principle – a negative foundation (Zupančič, 2017).
10. This points to the distributed, dynamic localization of the imaginary, which is not wholly lateralized to the right hemisphere. Apraxia impairs symbolic action, thus reflecting the intersection of these registers. The same applies for Bálint's syndrome.
11. In the Kleinian sense (Klein, 1946), not the Lacanian sense of the split-subject.
12. Not all cases of right hemisphere damage result in these psychological effects (Morin, 2018). This reflects both the dynamic localization of the system as well as the broad localization made in the present model.
13. This supports dynamic localization, where imaginary components (self-reflective consciousness) are distorted alongside symbolic disturbances.
14. As Kaplan-Solms and Solms (2002) point out, this supports Freud's argument that consciousness is not essential to the ego's function. Likewise, Lacan emphasizes the structuring role of the symbolic for the subject, rather than the conscious dimension of the imaginary ego.

Acknowledgements

An earlier version of this paper was written for a seminar taught by Joan Copjec. I would like to thank Joan Copjec and Brian Hayden for helpful comments on an earlier draft of this paper. I would also like to thank the reviewers for their comments, which significantly improved this paper. *Geolocation Information* This paper was written while in New York City, New York and Providence, Rhode Island in the United States.

Disclosure statement

No potential conflict of interest was reported by the author.

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References

Ansermet, F., & Magistretti, P. (2007). *Biology of freedom: Neural plasticity, experience, and the unconscious*. (S. Fairfield, Trans.). New York: Other Press.

Baddeley, A. (2003). Working memory: Looking back and looking forward. *Nature*, *4*, 829–883.

Baddeley, A., & Barbara, W. (1988). Frontal amnesia and the dysexecutive syndrome. *Brain and Cognition*, *7*(2), 212–230.

Badre, D., Kayser, A., & D'Esposito, M. (2010). Frontal cortex and the discovery of abstract action rules. *Neuron*, *66*(2), 315–326.

Bazan, A. (2011). Phantoms in the voice: A neuropsychoanalytic hypothesis on the structure of the unconscious. *Neuropsychoanalysis*, *13*(2), 161–176.

Bazan, A., & Detandt, S. (2013). On the physiology of jouissance: Interpreting the mesolimbic dopaminergic reward functions from a psychoanalytic perspective. *Frontiers in Human Neuroscience*, *7*, Article 709. doi:10.3389/fnhum.2013.00709

Bazan, A., & Detandt, S. (2017). The grand challenge for psychoanalysis and neuropsychoanalysis: A science of the subject. *Frontiers in Psychology*, *8*, Article 1259. doi:10.3389/fpsyg.2017.01259

Binder, J., & Desai, R. (2011). The neurobiology of semantic memory. *Trends in Cognitive Sciences*, *15*(11), 527–536.

Caramazza, A., & Coltheart, M. (2006). Cognitive neuropsychology twenty years on. *Cognitive Neuropsychology*, *23*(1), 3–12.

Carhart-Harris, R., & Friston, K. (2010). The default-mode, ego-functions and free-energy: A neurobiological account of Freudian ideas. *Brain*, *133*(4), 1265–1283.

Collins, A., & Loftus, E. (1988). A spreading-activation theory of semantic processing. In A. Collins, & E. Smith (Eds.), *Readings in cognitive science: A perspective from psychology*

and artificial intelligence (pp. 126–136). San Mateo, CA: Morgan Kaufmann.
Copjec, J. (2012). The sexual compact. *Angelaki*, *17*(2), 31–48.
Cottes, J.-F. (2003). Psychosis and the child in the teachings of Jacques Lacan: Consequences for an institution. *Courtil Papers*.
Damasio, A. (2005). *Decartes' error: Emotion, reason, and the human brain*. New York: Penguin Books.
Damasio, A. (2010). *Self comes to mind: Constructing the conscious brain*. New York: Pantheon.
DeCasper, A., & Fifer, W. (1980). Of human bonding: Newbrons prefer their mothers' voices. *Science*, *208*, 1174–1176.
Feinberg, T. (2010). Neuropathologies of the self: A general theory. *Neuropsychoanalysis*, *12*(2), 133–158.
Fink, B. (1999). *A clinical introduction to Lacanian psychoanalysis: Theory and technique*. Cambridge: Harvard University Press.
Fotopoulou, A. (2015). The virtual bodily self: Mentalisation of the body as revealed in anosognosia for hemiplegia. *Consciousness and Cognition*, *33*, 500–510.
Fotopoulou, A., Pernigo, S., Maeda, R., Rudd, A., & Kopelman, M. (2010). Implicit awareness in anosognosia for hemiplegia: Unconscious interference without conscious re-representation. *Brain*, *133*, 3564–3577.
Freud, S. (1895). Project for a scientific psychology. In *The standard edition of the complete psychological works of Sigmund Freud* (J. Strachey, Trans., Vol. I, pp. 281–391).
Freud, S. (1900). *The interpretation of dreams* (J. Strachey, Ed., & J. Strachey, Trans.) New York: Basic Books.
Freud, S. (1905). Three essays on the theory of sexuality. In *The standard edition of the complete psychological works of Sigmund Freud* (J. Strachey, Trans., Vol. VII, pp. 123–246). London: Hogarth Press.
Freud, S. (1915a). Instincts and their vicissitudes. In *The standard edition of the complete psychological works of Sigmund Freud* (J. Strachey, Trans., Vol. XIV, pp. 109–140). London: Hogarth Press.
Freud, S. (1915b). Repression. In *The standard edition of the complete psychological works of Sigmund Freud* (J. Strachey, Trans., Vol. XIV, pp. 141–158). London: Hogarth Press.
Freud, S. (1915c). The unconscious. In *The standard edition of the complete psychological works of Sigmund Freud* (J. Strachey, Trans., Vol. XIV, pp. 159–215). London: Hogarth Press.
Freud, S. (1923). The ego and the id. In *The standard edition of the complete psychological works of Sigmund Freud* (J. Strachey, Trans., Vol. XIX, pp. 1–66). London: Hogarth Press.
Goldenberg, G. (2009). Apraxia and the parietal lobes. *Neuropsychologia*, *47*, 1449–1459.
Guariglia, C., Palermo, L., Piccardi, L., Iaria, G., & Incoccia, C. (2013). Neglecting the left side of a city square but not the left side of its clock: Prevalence and characteristics of representational neglect. *PLoS ONE*, *8*(7), e67390.
Hebb, D. (1949). *The organization of behavior*. New York: Wiley & Sons.
Johnston, A. (2012). Reflections of a rotten nature: Hegel, Lacan, and material negativity. *Filozofski Vestnik*, *XXXIII*(2), 23–52.
Johnston, A. (2013a). Drive between brain and subject: An immanent critique of Lacanian neuropsychoanalysis. *The Southern Journal of Philosophy*, *51*(Spindel Supplement), 48–84.
Johnston, A. (2013b). Misfelt feelings: Unconscious affect between psychoanalysis, neuroscience, and philosophy. In A. Johnston, & C. Malabou (Eds.), *Self and emotional life: Philosophy, psychoanalysis, and neuroscience* (pp. 73–210). New York: Columbia University Press.
Johnston, A. (2015). Confession of a weak reductionist: Responses to some recent criticisms of my materialism. In J. De Vos, & E. Pluth (Eds.), *Neuroscience and critique: Exploring the limits of the neurological turn* (pp. 141–170). New York: Routledge.
Johnston, A. (2018). The late innate: Jean Laplanche, Jaak Panksepp, and the distinction between sexual drives and instincts. In J. Goldbach & J. Godley (Eds.), *Inheritance in psychoanalysis* (pp. 57–84). Albany: State University of New York Press.
Johnston, A. (2019). Fear of science: Transcendental materialism and its discontents. In R. Sbriglia, & S. Žižek (Eds.), *Subject lessions: Hegel, Lacan, and the future of materialism* (p. Forthcoming). New York: Columbia University Press.
Kahan, T., Sellinger, J., & Broman-Fulks, J. (2006). Associative and phonological priming effects after letter search on the prime. *The American Journal of Psychology*, *119*(2), 239–254.
Kaplan-Solms, K., & Solms, M. (2002). *Clinical studies in neuropsychoanalysis: Introduction to a depth neuropsychology* (2nd ed.). London: Karnac Books.
Klein, M. (1946). Notes on some schizoid mechanisms. *The International Journal of Psychoanalysis*, *27*, 99–110.
Lacan, J. (1953). Some reflections on the ego. *International Journal of Psycho-Analysis*, *34*(1), 11–17.
Lacan, J. (1975–1976). *The seminar of Jacques Lacan XXIII: Le sinthome*. (J.-A. Miller, Ed., & L. Thurston, Trans.) Ornicar?
Lacan, J. (1977). *Écrits: A selection*. (A. Sheridan, Trans). New York: W.W. Norton & Company.
Lacan, J. (1978). *The seminar of Jacques Lacan: The four fundamental concepts of psychoanalysis*. (J.-A. Miller, Ed., & A. Sheridan, Trans.) New York: Norton.
Lacan, J. (1988). *The seminar of Jacques Lacan: Freud's papers on technique*. (J.-A. Miller, Ed., & J. Forrester, Trans.). New York: Norton.
Lacan, J. (1993). *The seminar of Jacques Lacan: The psychoses*. (J.-A. Miller, Ed., & R. Grigg, Trans.). New York: Norton.
Lacan, J. (1997). *The seminar of Jacques Lacan: The ethics of psychoanalysis*. (J.-A. Miller, Ed., & D. Porter, Trans.) New York: Norton.
Lacan, J. (2000). *The seminar of Jacques Lacan: On feminine sexuality, the limits of love and knowledge*. (J.-A. Miller, Ed., & B. Fink, Trans.) New York: W. W. Norton & Company.
Lacan, J. (2007). *The seminar of Jacques Lacan: The other side of psychoanalysis*. (J.-A. Miller, Ed., & R. Grigg, Trans.) New York: W. W. Norton & Company.
Laplanche, J. (2011). *Freud and the sexual* (1st ed.). The Unconscious in Translation.
Laurent, E. (2014). *Lost in cognition: Psychoanalysis and the cognitive sciences*. (A. Price, Trans.). London: Karnac Books.
LeDoux, J. (2002). *Synaptic self: How our brains become who we are*. New York: Penguin Books.
Linden, D. (2008). *The accidental mind: How brain evolution has given us love, memory, dreams, and God*. Cambridge: Harvard University Press.
Magistretti, P., & Ansermet, F. (2012). The island of the drive. *Swiss Archives of Neurology and Psychiatry*, *163*(8), 281–285.
Matheson, H., & McMullen, P. (2010). Neuropsychological dissociations between motion and form perception suggest functional organization in extrastriate cortical regions in the human brain. *Brain and Cognition*, *74*, 160–168.
McGaugh, J. (2000). Memory: A century of consolidation. *Science*, *287*(5451), 248–251.

McGilchrist, I. (2009). *The master and his emissary: The divided brain and the making of the Western world*. New Haven: Yale University Press.
Merker, B. (2007). Consciousness without a cerebral cortex: A challenge for neuroscience and medicine. *Behavioral and Brain Sciences*, *30*(1), 63–81.
Miller, J.-A., & Roberts, M. D. (1996). The monologue of l'apparole. *Qui Parle*, *9*(2), 160–182.
Milner, A., & Goodale, M. (2008). Two visual systems re-viewed. *Neuropsychologia*, *46*, 774–785.
Milner, B., Squire, L., & Kandel, E. (1998). Cognitive neuroscience and the study of memory. *Neuron*, *20*, 445–468.
Morin, C. (2018). *Stroke, body image, and self-representation: Psychoanalytic and neurological perspectives*. (K. Valendinova & C. Morin, Trans.). New York: Routledge.
Morin, C., Pradat-Diehl, P., Robain, G., Bensalah, Y., & Perrigot, M. (2003). Stroke hemiplegia and specular image: Lessons from self-portraits. *The International Journal of Aging and Human Development*, *56*(1), 1–41.
Moruzzi, G., & Magoun, H. (1949). Brain stem reticular formation and activation of the EEG. *Electrocephalography and Clinical Neurophysiology*, *1*, 455–473.
Muller, J. (1985). Lacan's mirror stage. *Psychoanalytic Inquiry*, *5* (2), 233–252.
Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions*. New York: Oxford University Press.
Panksepp, J., & Solms, M. (2012). What is neuropsychoanalysis? Clinically relevant studies of the minded brain. *Trends in Cognitive Sciences*, *16*(1), 6–8.
Penfield, W., & Jasper, H. (1954). *Epilepsy and the functional anatomy of the human brain*. Oxford: Little & Brown.
Price, C., Moore, C., Humphreys, G., & Wise, R. (1997). Segregating semantic from phonological processes during reading. *Journal of Cognitive Neuroscience*, *9*(6), 727–733.
Ptak, R., & Fellrath, J. (2014). Exploring the world with bálint syndrome: Biased bottom-up guidance of gaze by local saliency differences. *Experimental Brain Research*, *232*(4), 1233–1240.
Rapcsak, S., Beeson, P., Henry, M., Leyden, A., Kim, E., Rising, K., … Cho, H. (2009). Phonological dyslexia and dysgraphia: Cognitive mechanisms and neural substractes. *Cortex*, *45* (5), 575–591.
Redmond, J. (2015). Debating the subject: Is there a Lacanian neuropsychoanalysis? *Psychoanalysis Lacan*, *1*. Retrieved from http://psychoanalysislacan.com/issue-1/
Ribolsi, M., Feyaerts, J., & Vanheule, S. (2015). Metaphor in psychosis: On the possible convergence of Lacanian theory and neuro-scientific research. *Frontiers in Psychology*, *6*, Article 664. doi:10.3389/fpsyg.2015.00664
Richmond, J., & Nelson, C. (2007). Accounting for change in declarative memory: A cognitive neuroscience perspective. *Developmental Review*, *27*(3), 349–373.
Roediger, H., & Geraci, L. (2007). Aging and the misinformation effect: A neuropsychological analysis. *Journal of Experimental Psychology*, *33*(2), 321–334.
Salas, C., & Coetzer, R. (2015). Is concreteness the invisible link between altered emotional processing, impaired awareness and mourning difficulties after traumatic brain injury? *Neuropsychoanalysis*, *17*(1), 3–18.
Schachter, D. (1987). Memory, amnesia, and frontal lobe dysfunction. *Psychobiology*, *15*(1), 21–36.
Shewmon, D., Holmes, G., & Byrne, P. (1999). Consciousness in congenitally decorticate children: Developmental vegetative state as self-fulfilling prophecy. *Developmental Medicine & Child Neurology*, *41*, 364–374.
Solms, M. (2012a). Are Freud's "erogenous zones" sources or objects of libidinal drive? *Neuropsychoanalysis*, *14*, 53–56.
Solms, M. (2012b). Depression: A neuropsychoanalytic perspective. *International Forum of Pscyhoanalysis*, *21*, 207–213.
Solms, M. (2013). The conscious id. *Neuropsychoanalysis*, *15*(1), 5–19.
Solms, M. (2015). *The feeling brain: Selected papers on neuropsychoanalysis*. London: Karnac Books.
Solms, M. (2017a). "The unconscious" in psychoanalysis and neuroscience: An integrated approach to the cognitive unconscious. In M. Leuzinger-Bohleber, S. Arnold, & M. Solms (Eds.), *The unconscious: A bridge between psychoanalysis and cognitive neuroscience* (pp. 16–35). London: Routledge.
Solms, M. (2017b). What is "the unconscious," and where is it located in the brain? A neuropsychoanalytic perspective. *Annals of the New York Academy of Sciences*, *1406* (1), 90–97.
Solms, M., & Turnbull, O. (2002). *The brain and the inner world: An introduction to the neuroscience of subjective experience*. New York: Other Press.
Thibierge, S., & Morin, C. (2010). The self and the subject: A psychoanalytic Lacanian perspective. *Neuropsychoanalysis*, *12* (2), 171–184.
van der Kolk, B. (2014). *The body keeps the score: Brain, mind, and body in the healing of trauma*. New York: Penguin Books.
Vanheule, S. (2011). Lacan's construction and deconstruction of the double-mirror device. *Frontiers in Psychology*, *2*, Article 209. doi:10.3389/fpsyg.2011.00209.
Verhaeghe, P. (2004). *On being normal and other disorders: A manual for clinical psychodiagnostics*. (S. Jottkandt, Trans.). New York: Other Press.
Waterson, M., & Horvath, T. (2015). Neuronal regulation of energy homeostasis: Beyond the hypothalamus and feeding. *Cell Metabolism*, *22*, 962–970.
Williams, G., Harrold, J., & Cutler, D. (2000). The hypothalamus and the regulation of energy homeostasis: Lifting the lid on a black box. *Proceedings of the Nutrition Society*, *59*, 385–396.
Willis, C., & Gathercole, S. (2001). Phonological short-term memory contributions to sentence processing in young children. *Memory*, *9*, 349–363.
Woods, S., Seeley, R., Porte, D., & Schwartz, M. (1998). Signals that regulate food intake and energy homeostasis. *Science*, *280*(5368), 1378–1383.
Yeates, G., Henwood, K., Gracey, F., & Evans, J. (2006). Awareness of disability after acquired brain injury: Subjectivity within the psychosocial context. *Neuro-Psychoanalysis*, *8*(2), 175–189.
Zupančič, A. (2017). *What IS sex?* Cambridge, MA: MIT Press.